deflection characteristic wherein the mechanical actuator is comprised of a spring, and a means for externally controlling the preload to said spring.

REMARKS

Claims 1 and 2 are pending in this application. Claims 1 and 2 have been rejected. Claim 1 has been amended as supported on page 4, lines 20-26; page 6 lines 23-24 and page 8, lines 16-19. Claim 2 has been amended as supported on page 4, lines 20-26, and page 8 lines 6-7. Figures 1 and 2 have been amended as supported throughout the specification and in Figures 1 and 2 as filed. No new matter has been added by this amendment. Applicants respectfully request reconsideration in view of the following remarks.

I. Objection to Drawings

The Drawings are objected to because several views are shown in Figures 1 and 2. It is requested that the different views must be numbered in consecutive numerals. In accordance with 37 CFR 1.84 (u)(1), the different views have been numbered in consecutive Arabic numerals, starting with 1, independent of the numbering of the sheets. The existing partial views intended to form one complete view of Figure 1 and Figure 2 have been designated by the identified figure numeral followed by a capital letter. The view numbers are preceded by the abbreviation "FIG."

A proposed drawing correction is enclosed herewith. Figure 1 has been corrected to designate the views of the invention as FIG 1A, FIG 1B and FIG 1C. Figure 2 has been amended to designate the views as FIG 2A, FIG 2B, and FIG 2C.

It is further suggested that the drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "32" and "42" have both been used to designate the component shown immediately above the element represented by number 22 in the middle view (now FIG 1B) of Figure 1. Fig. 1A has been corrected to show that the component "42" is located above the component "32".

The drawings are further objected to under 37 CFR 1.83(a) as not showing every feature of the invention specified in the claims. Specifically, it is suggested that the passive isolator must be shown and clearly labeled or canceled from the claims. Applicants respectfully disagree that the passive isolator is not clearly labeled and shown, as it is obvious to one of skill in the art and as described on page 2, lines 9 through 27 of the specification that the passive isolator component is number 14 in the Figure 1. However, claims 1 and 2 have been amended to clarify that the passive isolator has a nonlinear force-deflection characteristic as supported throughout the specification and at page 4, lines 21-26.

Applicants believe that this amendment overcomes the Examiner's objection.

II. Specification

The disclosure is objected to because of the informalities. The Examiner suggests that there is not a new element number to represent the "rubber bellows". In order to clarify the invention, the specification has been amended at page 4, lines 13, 27, 28, to clarify that the rubber bellows in the upper pressure chamber are "upper rubber bellows **38**" and the rubber bellows in the lower pressure chamber are "lower rubber bellows **48**". Applicants believe that this amendment overcomes the Examiner's objection.

III. Rejection of claims under 35 U.S.C. §112, second paragraph

The Examiner has rejected claims 1 and 2 under 35 U.S.C. §112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner suggests that the recitation of both a passive isolator and a non-linear spring is unclear. The Examiner has interpreted the passive isolator to form part of the non-linear spring. The Examiner suggests that in light of this interpretation claims 1 and 2 are indefinite. As discussed above, claims 1 and 2 have been amended

to clarify that the passive isolator has a nonlinear force-deflection characteristic and that both the pneumatic and mechanical actuators vary the operating point of the isolator along said force-deflection characteristic. Support for these amendments is found throughout the specification and at page 4 lines 20-26 and page 8 lines and page 8, line 19.

IV. Rejection of claims under 35 U.S.C. §102(b)

The Examiner has rejected claim 1 under 35 U.S.C. §102(b)as being anticipated by McConnell(U.S. Patent 4,854,541). Specifically, the Examiner suggests that McConnell shows in Figures 3 and 4 a device for adaptive vibration attenuation comprising a passive isolator and a pneumatic actuator which varies stiffness characteristics.

Claim 2 is rejected under 35 U.S.C. §102(b) as being anticipated by Popper (U.S. Patent No.4,674,725). Popper is suggested to show in Figure 2, a device for adaptive vibration attenuation comprising a passive isolator 40 and a mechanical actuator 38, 36 which varies stiff characteristics wherein the mechanical actuator is comprised of a spring 38, a non-linear spring 44, 40, an upper plate of 32, and a load supporting rod 36, wherein the load supporting rod passes through the center of the coiled spring. Applicants respectfully disagree.

First, the invention by McConnell describes a purely passive isolator (i.e., there is no actively controlled element), which is based on energy absorption using several passive pneumatic dampers. Our invention comprises an active pneumatic actuator, i.e., one that is pressurized by an external pressure source in order to apply a preload on a nonlinear spring, such that the operating point on the nonlinear force-vs-deflection curve of the spring can be changed as desired. In the invention by McConnell, the purpose of being able to manually change (presumably one time) the spring preload (by threaded lead screws) is to permit the adjustment of the height to which the spring holds the power line. In the present invention, claim 1 has been amended to clarify that the device for adaptive vibration attenuation comprises a passive isolator with a nonlinear force-deflection characteristic and a pneumatic actuator which varies the operating point of said isolator along said force-deflection characteristic wherein said pneumatic actuator comprises at least one pressure chamber wherein the pressure in the chamber can be externally controlled, as supported at pages 4 and 8. The present invention applies an externally changeable preload to the nonlinear spring in order to adjust the operating point on the

nonlinear force-vs-deflection curve of the spring as desired such that the natural frequency of the system can be changed at will.

Second, the invention by Popper teaches various passive shock and vibration attenuation devices. In contradiction to the Examiner's statement, there is no mechanical actuator (i.e., element that is externally controllable) in Figure 2 of Popper. In the invention by Popper, a means for adjusting the Coulomb friction forces, which are used as the main principle to dampen vibrations, is provided. In claim 2 of the present invention, an externally adjustable means (mechanical or pneumatic) for applying (at will) a preload on a nonlinear spring is provided. In the present invention, no explicit damping element (i.e., Coulomb or otherwise) is specified. In the invention by Popper, nonlinear springs are used for restoring the system to its equilibrium state and for changing the Coulomb friction forces as a function of the vibration amplitude. In the present invention, a nonlinear spring is used in order to be able to adjust the natural frequency of the attenuation device by applying an appropriate spring preload. Popper does not teach a mechanical actuator nor that a damping element is not required, therefore this reference cannot anticipate claim 2 as amended.

It is therefore respectfully requested that this rejection be withdrawn.

V. Conclusion

Applicants believe that the foregoing comprises a full and complete response to the Office Action of record. Accordingly, favorable reconsideration and subsequent allowance of the pending claims is earnestly solicited.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment, captioned "Version with Markings to Show Changes Made". The proposed drawing changes are also attached.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Please replace the paragraph beginning at page 4, line 13, with the following rewritten paragraph:

~~Figure 1 shows~~ Figures 1A, 1B and 1C show a side view of a pneumatic system with two pressure chambers.

Please replace the paragraph beginning at page 4, line 15, with the following rewritten paragraph:

~~Figure 2 shows~~ Figures 2A, 2B and 2C show a side view of a mechanical system.

Please replace the paragraph beginning at page 4, line 29, with the following rewritten paragraph:

~~Figure 1 shows~~ Figures 1A, 1B, and 1C show a side view of a pneumatic unit comprising an upper pressure chamber **10** and a lower pressure chamber **12** present on either side of a non-linear spring **14**, a load supporting rod **16**, a top support plate **18**, a bottom support plate **20**, a supporting plate **22**, fasteners **24** and connectors **26**. The non-linear spring **14** is comprised of an upper metal support **28**, an elastomeric isolator **30**, and a lower metal

support **32**. The upper pressure chamber is comprised of a top side **34**, an upper cylindrical side wall **36** with a top edge and a bottom edge, upper rubber bellows **38**, an upper air inlet **40**, and a bottom side to the upper pressure chamber **42**. The lower pressure chamber **12** is comprised of a top side **44**, a lower cylindrical side wall **46**, lower rubber bellows **48**, a lower air inlet **50**, and a bottom to the lower pressure chamber **52**. The upper pressure chamber contains upper rubber bellows **38** with a top edge **54** and bottom edge **56**. The top edge **54** of the upper rubber bellow **48** is secured between the underside of the upper pressure chamber top **34** and the top edge of the cylindrical side wall **36**. The bottom edge of the upper pressure chamber upper rubber bellows **38** is secured between the bottom edge of the cylindrical side wall **36** and the top edge of the lower metal support **32** of the nonlinear spring **14**. The lower pressure chamber **12** contains a lower rubber bellows **48** with a top and bottom edge. The top edge of the lower rubber bellow **48** is secured between the bottom side of the lower metal support **32** and the top edge of the lower pressure chamber cylindrical side wall **46**. The bottom

edge of the lower rubber bellow **48** is secured between the bottom edge of the cylindrical side wall **46** and the top edge of the bottom support plate **20**. The upper pressure chamber upper rubber bellows **38** and lower pressure chamber lower rubber bellows **48** secured in this way each take on a doughnut shape. An upper air inlet **40** present on the cylindrical side wall **36** of the upper pressure chamber **10** allows air to be pumped into the upper pressure chamber **10** which transfers increased load onto the nonlinear spring **14**. A top support plate **18** is in contact with the top side of the upper pressure chamber **10**. The top support plate **18** is attached by fasteners **24** to connectors **26** which are attached to the top side of a supporting plate **22**. The bottom side of the support plate **22** is attached to the bottom support plate **20** by multiple fasteners **24** to the under side of the bottom support plate. A load supporting rod **16** runs from the top support plate **18** through the center of: the space in the center of the upper rubber bellows **38** in the upper pressure chamber **10**, the nonlinear spring **14**, the supporting plate **22**, space in the center of the lower rubber bellows **48** in the lower pressure

chamber **12** and the bottom support plate **20**. The load supporting rod **16** has a smaller diameter at the lower end and a larger diameter at the upper end. The larger diameter end of the load supporting rod **16** passes through the center of the top support plate **18** and through the space in center of the doughnut shaped upper rubber bellows **38** of the upper pressure chamber **10**. Due to its larger dimension, the larger diameter end of the load supporting rod **16** can not pass through the hole in the top of the upper metal support **28** of the nonlinear spring **14**. The actuator is part of a pneumatic system including a pump, pressure chambers, and a pressure reservoir to facilitate rapid response times for stiffening and softening. By introducing air into the upper pressure chamber **10**, a load is applied to the nonlinear spring. Similarly, the lower pressure chamber **12** reduces the load on the non-linear spring **14**. A load due to pressure in the upper chamber is added to the external supported load while a load due to pressure in the lower chamber is subtracted from the external supported load. The nonlinear spring **14** stiffness changes with varying loads. By applying pressure to either the upper pressure chamber **10** or the lower pressure chamber **12**, the natural frequency of the system may be regulated. One or two

pressure chambers may be present depending on the application. Using this device, adaptive vibration attenuation is implemented by passive vibration mounts that allow the adjustment of their dynamic stiffness characteristics in response to changes in the excitation or loading conditions. The mount stiffness is varied by combining a passive vibration mount with highly non-linear force-deflection characteristics with a one-directional or bi-directional pneumatic actuator. These adjustments of mount characteristics result a change of the natural frequency by shifting the operating point of the nonlinear spring. Non-invasive, non-contact sensors are used together with hardware- or software-based signal processing to identify the excitation displacement and/or force signal and to generate the appropriate adjustments of the passive vibration mount characteristics.

Please replace the paragraph beginning at page 7, line 16, with the following rewritten paragraph:

~~Figure 2 shows~~ Figures 2A, 2B, and 2C show a side view of a mechanical system. In instances where stiffness adjustments do not have to be accomplished remotely or frequently, a less expensive alternative to the pneumatic system is a mechanical pre-tensioning spring. The mechanical unit is comprised of a coil spring **58**, a non-linear spring **14**, a load supporting rod **16**,

a top support plate **18**, a supporting plate **22**, spring adjustments **60**, fasteners **24**, and connectors **26**.

In the Claims:

Claims 1 and 2 have been amended as follows:

1. (Twice amended) A device for adaptive vibration attenuation comprising a passive isolator with a nonlinear force-deflection characteristic and a pneumatic actuator which varies ~~stiffness characteristics~~ the operating point of said isolator along said force-deflection characteristic wherein the pneumatic actuator comprises ~~an upper~~ at least one pressure chamber ~~and a lower pressure chamber present on either side of a non-linear spring~~ wherein air pressure in said pressure chamber can be externally controlled.

2. (Twice amended) A device for adaptive vibration attenuation comprising a passive isolator with a nonlinear force-deflection characteristic and a mechanical actuator which varies the operating point of said passive isolator along said force-deflection characteristic ~~stiffness characteristics~~ wherein the mechanical actuator is comprised of a ~~coiled spring, a non-linear~~ spring, and a ~~load supporting rod, and wherein the load~~

~~supporting rod passes through the center of the coiled spring~~ means for externally controlling the preload to said spring.